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(54) IMPROVEMENTS IN OR RELATING TO WEIGHING DEVICES

(71) We, CONRAIL AB, a Swedish body Corporate of Lidmansvägen 7, 724 61 Västerås, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This present invention relates to a device for weighing railguided vehicles such as railway wagons, trucks of different kinds, trains, overhead cranes, or hopper cars.

It is known that vehicles on rails can be weighed by means of platform scales, arranged in weighing pits in the path of the vehicle. One example of such a scale for railway wagons is shown, for instance, in a pamphlet from Toledo called Toledo Steel Master Levers printed in the U.S.A by Toledo Scale Corporation, Toledo, Ohio 43612. On the upper surface of the platform a rail of some kind, for instance a channel beam for a rubber wheel or a railway rail for railway car wheels is arranged, with its upper surface in the same plane as the upper surfaces of the fixed rails outside the scale, but disconnected from the fixed rails by an open joint at each end, so that the rail section carried by the scale is free to move vertically. The load is sensed by means of, for instance, a mechanical weighing system or loads cells. The requirement for a stiff and solid support for a scale has in existing systems been provided by extensive and expensive scale foundations, which means that these systems are fixed, in position, and cannot be moved to the most suitable position for weighing, for instance during loading of railway cars from ships.

It is further unsuitable to arrange such a weighing device in a rail system for railway cars where the trains must be allowed to pass the scale at full speed when the cars are not to be weighed. Such an installation would lead to abnormal wear in the joint between the weigh platform and adjoining rails in addition to imposing damaging stresses on the weighing device. For weighing railway cars in particular, a large number of other devices are known which are based on the principle that a section of

the rail system contains some kind of scale which is fixed, in position, and which senses the load *via* the upper surface of the rail, or *via* another rail replacing the main rail.

Examples of such known systems are found in British Patent Specification Nos. 820,969, 797,161 and 832,389 and other forms are shown in U.S. Patent Specification No. 3,085,642, German Patent Specification No. DBP 1,079,338, French Patent Specification Nos. 1,292,587, 974,974 and Swedish Patent Specification No. 217,810.

It is an object of the present invention to eliminate the extensive and expensive scale foundation required by known weighing devices whilst obtaining acceptable weighing accuracy. Furthermore it should, with a device according to the present invention, be possible to weigh both stationary vehicles in motion with an accuracy equal to or exceeding the accuracy attained with known stationary devices.

According to a first aspect of the present invention there is provided a device for weighing a rail-guided vehicle, which device comprises a frame portion adapted to be supported by feet or webs of rails, or by rail support means so that the frame portion is movable in accordance with flexion of the rails, the frame portion including two beams which are spaced apart from one another and which are adapted to extend transversely relative to the rails, load sensing means supported by the frame portion, and a vehicle supporting means which is supported by the load sensing means, the vehicle supporting means having two vehicle supporting portions which are adapted to extend parallel to and adjacent respective rails, the vehicle supporting portions being connected for angular movement relative to one another about an axis substantially perpendicular to the vehicle supporting portions and in the plane thereof so that the vehicle supporting portions are movable in accordance with movement of the frame portion.

According to a second aspect of the present invention there is provided a device for weighing a rail-guided vehicle, which device comprises a frame portion, supported by feet or webs of rails, or by rail support

means, so that the frame portion is movable in accordance with flexion of the rails, the frame portion including two beams which are spaced apart from one another and which extend transversely relative to the rails, load sensing means supported by the frame portion, and a vehicle supporting means which is supported by the load sensing means, the vehicle supporting means having two vehicle supporting portions which extend parallel to and adjacent respective rails, the vehicle supporting portions being connected for angular movement relative to one another about an axis substantially perpendicular to the rails and in the plane thereof so that the vehicle supporting portions are movable in accordance with movement of the frame portion.

A device according to the invention can for instance be arranged in an existing rail system without need for modification therein, and the device can be easily moved to the most suitable position with regard to, for instance, the loading process. Hereby the device becomes an integrated part of the rail system and, since the device is not mounted in a large scale foundation having different elastic properties from the rail system itself, a weighing device according to the invention accordingly will follow the movement of the rails so that a perfectly defined force on the load sensing means is obtained independent of the elastic properties of the rail and the rail foundation. It is even possible to tolerate different elastic properties in the two opposing rails at the point where the device is mounted so that one rail attains a different slope than the other, without influence on the weighing result. Because the stationary scale foundations and scale platforms have been eliminated, one has further obtained the advantage, that if the device according to the invention malfunctions, it can easily be removed from the rail system so that normal traffic across the weighing station is not disturbed.

In one embodiment of the invention the device is provided with rollers or wheels so that the weighing device can be moved, possibly through remote control, along the rail system. The device can even be provided with devices so that it can be automatically or manually locked in an inoperative position whereby vehicles can pass over the weighing device without contacting it.

The device according to the invention is exceptionally suitable for use in connection with automatic loading or unloading stations for different types of bulk material such as coal, ore, scrap, lumber or grain, in which the loading process can be automatically controlled by means of signals so that the load in the car is suitably distributed and where the weight data can be used as a

basis for invoicing. The cost savings that can be achieved in this way are substantial because of increased utilisation of cars and thereby reduced labour costs, and because the risk of overload and incorrect loading is eliminated, thereby avoiding necessary time consuming and expensive reloading. It is also possible to check that safety standards for cars and railways are not exceeded and the risk of a derailment because of incorrect load distribution is reduced. As an example of such an automatic loading station can be mentioned a modern ore depot in which a tunnel is arranged through the depot and loading openings are arranged in the ceiling of the tunnel. The ore is dumped into the cars in a train passing under the loading openings. There can be a large number of loading openings and these can be used alternatively. In order to obtain maximum utilisation and best possible movement of the train each car must be weighed and the loading controlled so that all cars are fully and equally loaded.

With known weighing technology it has been necessary to build a scale foundation and a scale for each possible position, which is a very large investment and causes an almost impossible service situation when the process is continuous.

With the device according to the present invention, however, only as many weighing devices are required as are actually used in each instance and each system costs only about $\frac{1}{3}$ of the cost of a conventional system. Furthermore it is possible to replace the entire system for service in a short time, whereby the loading process is hardly disturbed.

With a device according to the invention it is very simple to automate even existing systems without shutdowns, which is entirely impossible with a conventional system.

Another important application for the invention is loading and unloading of bulk material from ships to railway cars or vice versa. Because ships are of different lengths and have different distances between hatches, and are positioned at the pier in the order they arrive, a scale for weighing the railway cars must quickly be placed in a suitable weighing position. It is thus evident that the present invention can replace most of the known stationary systems with good technical and economical effect.

For a better understanding of the present invention and to show how the same may be carried into effect reference will now be made by way of example, to the accompanying drawings in which:—

Figure 1a shows a cross section through a weighing device according to the invention, wherein the load sensing means are load cells of compression type;

Figure 1b shows a section taken along the line A—A in Figure 1a;

Figure 2 shows a detail of part of another weighing device according to the invention, wherein the load cells are shear sensing transducers;

Figure 3 shows a detail of part of another weighing device according to the invention, wherein the load cells are bending stress sensing transducers,

Figure 4a shows a section taken along the line B—B in Figure 7b,

Figure 4b shows a section taken along the line C—C of Figure 7b,

Figures 5 and 6 show part of respective weighing devices according to the invention, the devices being adapted for weighing vehicles having widened wheels,

Figure 7a shows a cross section taken along the line A—A in Figure 7b of another weighing device according to the invention,

Figure 7b shows a plan of the weighing device according to Figure 7a,

Figure 7c shows a detail of Figure 7a with an eccentric pin in an opposite position,

Figures 8 and 9 show part of respective weighing devices, according to the invention, provided with means for moving the devices along the main rails;

Figure 10a shows a section, taken along the line B—B in Figure 10b, of another device in accordance with the present invention,

Figure 10b shows a section taken along the line A—A of Figure 10a, and

Figure 10c shows a plan view of the device of Figure 10a.

Figure 1a shows a weighing device according to the invention in which the load is transmitted via the flanges 1 of the vehicle wheel to rail portions 2 of a vehicle supporting means 3 of the weighing device and is transferred therefrom through load cells 4. The rail portions 2 can be removed from the vehicle supporting means for replacement, when worn.

The rail portions 2 are connected, by an intermediate portion of the vehicle supporting means 3, the intermediate portion being flexible such that the rail portions 2 are movable relative to one another about an axis substantially perpendicular to the rails and in the plane thereof.

The load cells 4 are supported by a frame part which comprises two beams 5 which rest in recesses in carrier rails 9 fitted to the rail profiles. The carrier rails 9 rest against the upper surface of the rail feet 10, and against the webs of the rails, which upstand from the rail feet 10. The carrier rails 9 are arranged to restrain lateral and/or longitudinal movement of the frame part relative to the rails and to transmit a vertical force on the frame part to the rail feet 10. Figure 1b shows that the rail portions 2

are provided with inclined end sections 6 and a higher middle section 7 so that a wheel passing over the scale will roll up-hill as the rail portions 2 are contacted by the flange 1 and, when it is on the middle section, the wheel is entirely free from the rail and supported by the vehicle supporting means 3.

The load cells are protected against side loads by means of tie rods 8 which are rigid in the horizontal direction but flexible in the vertical direction.

In those cases where load cells 4 are used, which by themselves can withstand existing side forces, for instance shear sensing transducers of the type comprising a beam arranged to be deflected under a load exerted thereon by a vehicle supporting portion, such tie rods are of course unneeded, as shown in the Figures 2, and 7a—c.

By introducing rails 9 between the frame part and the main rails as shown in Figures 1a and 1b, it is possible, without disassembly of the main rails to quickly install the frame part. Each rail 9 is fixed to the main rail by means of fastening members 11, for instance clamps (see also Figures 10a—c and 4a) which are clamped on the inner part of the rail foot. The locking can of course even be performed more permanently in many other ways, for instance through stops welded to, or mounting holes disposed in the feet or webs of the rails or means mounted in the rail foundation. This is for instance suitable when there are a limited number of weighing positions between which the scale is to be moved.

Figure 2 shows how the beams 5 of the frame part can be designed so that the load from the vehicle is supported by a surface adjacent the centre line of the rail foot 10. Figure 2 also shows how the beams 5 of the frame part can be supported against the web of the rail. The beams 5 of the frame part can alternatively be supported by the rail foundation 16, as shown in Figure 3, or by another support between the rails, whereby it can, for instance, be supported against the inner edge of the rail foot 10.

Figures 4a, b and 7a—c show an embodiment comprising a frame part which includes two parallel beams 5, which are arranged transversely relative to the rails and provided with pins 14 in each end, which fit in recesses 15 (see Figure 4b) on carrier rails 9 mounted on the main rails. These beams can either be unconnected to each other or interconnected. According to this embodiment the beams 5 are interconnected by means of a shaft 22, which is pivotally journaled in each beam so that the beams 5 can move relative to one another about an axis substantially parallel to the rails and in the plane thereof. The vehicle supporting means also comprises two parallel beams 3,

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which are connected to allow for relative rotation by means of a horizontal axle 12.

In Figures 7a and 7c it can be seen that the axle 12 has been provided with eccentric pins 13 at its ends and that the vehicle supporting beams 3 have been provided with corresponding journals, so that the device can be lowered and the scale locked when the weighing device is in an inoperative position. Figure 7a shows the device in position for weighing, while Figure 7c shows the position with the axle turned 180°, so that the vehicle supporting means is forced to turn through the action of the eccentric mechanisms so that the load carrying surface is lowered to a position below the wheel flanges. The turning of the axle can be effected either manually with a handle 21 or by means of a motor so that it can simply be remote controlled. The desired lowering can of course also be obtained by means of jacks or removable shims.

Instead of using an axle 12 the ends of which are pivotally mounted in journals of the vehicle supporting beams 3, the beams 3 may be rigidly connected to respective ends of an axle member which can twist about its axis to allow for relative rotational movement of the beams 3.

Figures 5 and 6 show respective alternative embodiments in which the wheels of the vehicles have been made wider than the rail itself at the weighing stations, so that the vehicle supporting part can cooperate with the part of the wheel which is outside and inside, respectively, the main rail.

In order to reduce the effect of the coupling between the cars in the train, one or more of the cars preceding and following the car being weighed can be arranged on the same level as the car which is being weighed.

Figures 8 and 9 show devices in accordance with the present invention in which the frame part 5 is provided with extendable wheels 17 or 18 arranged to roll either on the top surface of the rail between different weighing stations, or on the upper surface of the rail foot. In the latter case one gains the advantage that the weighing device can be moved under a train standing on the main rail.

Figures 10a-c show an embodiment comprising a vehicle supporting part 3 having flanges 21 at opposite edges thereof. The wheels of a vehicle ride on the flanges 21, in use of the device, and the vehicle supporting part 3 is flexible such that the flanges 21 are movable relative to one another about an axis substantially perpendicular to the main rails and in the plane thereof. The main rails each have a cut-out portion 20 so that the width of the main rail is reduced at the weighing station, and the flanges 21 are disposed within the profile of the main rail

wheel supporting portions which are remote from the flanges 21. The vehicle wheels are thus supported by the flanges 21 on part of the normal load periphery of the wheels and not on the flanges of the wheels. The main rails have a depression 19 at the weighing station and the wheel supporting surfaces of the flanges 21 are exactly in the same plane as the wheel supporting surfaces of the main rail wheel supporting portions which are remote from the flanges 21. This permits a smooth movement of vehicles over the weighing device because the wheels are not lifted by the flanges 21. Furthermore, the weighing accuracy is entirely independent of wear of the vehicle wheels which could otherwise affect the weighing due to differences in the height of the wheel flanges of different vehicles.

WHAT WE CLAIM IS:—

1. A device for weighing a rail-guided vehicle, which device comprises a frame portion adapted to be supported by feet or webs of rails, or by rail support means so that the frame portion is movable in accordance with flexion of the rails, the frame portion including two beams which are spaced apart from one another and which are adapted to extend transversely relative to the rails, load sensing means supported by the frame portion, and a vehicle supporting means which is supported by the load sensing means, the vehicle supporting means having two vehicle supporting portions which are adapted to extend parallel to and adjacent respective rails, the vehicle supporting portions being connected for angular movement relative to one another about an axis substantially perpendicular to the vehicle supporting portions and in the plane thereof so that the vehicle supporting portions are movable in accordance with movement of the frame portion.

2. A device according to claim 1, wherein the beams of the frame portion are connected for angular movement relative to one another about an axis substantially parallel to the vehicle supporting portions and in the plane thereof.

3. A device according to claim 1 wherein the frame portion is directly supported by rail support means.

4. A device according to claim 1 wherein the frame portion rests in carrier means supported by the feet or webs of main rails, or by rail support means.

5. A device according to claim 4, wherein the carrier means is arranged to restrain lateral and/or longitudinal movement of the frame portion relative to the rail and is arranged to transmit a vertical force on the frame portion to a foot portion of the rail which foot portion is adjacent a rail portion upstanding from the foot of the rail.

6. A device according to claim 5, wherein the carrier means comprises two carrier rails which rest on the upper surface of the rail feet, the carrier rails being provided with recesses intended to support the beams of the frame portion.

7. A device according to any one of the preceding claims, wherein the vehicle supporting portions each have end portions which are inclined to a higher intermediate portion intended to cooperate with a respective wheel of a vehicle so that in use of the weighing device, the load on the rails is transferred to the vehicle supporting means when the wheels are over the weighing device.

8. A device according to any one of the preceding claims, wherein the frame portion is provided with wheels, the wheels being movable from a first position in which the wheels do not engage the rails, to a second position in which the wheels can roll on the rails.

9. A device according to any one of the preceding claims, wherein each vehicle supporting portion comprises a beam.

10. A device according to any one of the preceding claims, wherein each vehicle supporting portion is rigidly connected to a connecting member which, in use of the device, extends transversely of the rails.

11. A device according to any one of claims 1 to 9, wherein each vehicle supporting portion is pivotally connected to a connecting member which extends, in use of the device, transversely of the rails.

12. A device according to claim 11, wherein the vehicle supporting portions are connected by an axle member portions of which are eccentrically journaled in a respective vehicle supporting portion, means being provided for rotating the axle member whereby the weighing device is displaceable from an operative position wherein the wheels of a vehicle roll on the vehicle supporting portions, to a lower inoperative position wherein the wheels of the vehicle cannot roll on the vehicle supporting portions.

13. A device according to any of preceding claims wherein each vehicle supporting portion comprises a rail on which the wheels of the vehicle roll, the rail being removable when worn, from the vehicle supporting portion for replacement.

14. A device according to any one of the preceding claims, wherein the weighing device is held in position in the longitudinal direction of the rails by means of clamps clamped on the foot of the rails or by means of stops welded to, or mounting holes disposed in, the foot or web of the rails.

15. A device according to any one of the

preceding claims, wherein the load sensing means comprises at least one shear sensing transducer including a beam which is deflected under a load exerted thereon by the vehicle supporting portion.

16. A device for weighing a rail-guided vehicle, which device comprises a frame portion, supported by feet or webs of rails, by rail support means, so that the frame portion is movable in accordance with flexion of the rails, the frame portion including two beams which are spaced from one another and which extend transversely relative to the rails, load sensing means supported by the frame portion, and a vehicle supporting means which is supported by the load sensing means, the vehicle supporting means having two vehicle supporting portions which extend parallel to and adjacent respective rails, the vehicle supporting portions being connected for angular movement relative to one another about an axis substantially perpendicular to the rails and in the plane thereof so that the vehicle supporting portions are movable in accordance with movement of the frame portion.

17. A device according to claim 16, wherein the width of wheel supporting rail portions adjacent the vehicle supporting portions of the vehicle supporting means is less than the width of wheel supporting rail portions which are remote from the vehicle supporting portions of the vehicle supporting means.

18. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figures 1a and 1b of the accompanying drawings.

19. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in Figure 2 of the accompanying drawings.

20. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figure 3 of the accompanying drawings.

21. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figures 4a, 4b, 7a, 7b and 7c of the accompanying drawings.

22. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figure 5 of the accompanying drawings.

23. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figure 6 of the accompanying drawings.

24. A device according to claim 1, substantially as hereinbefore described with reference to, and as shown in Figure 8 of the accompanying drawings.

25. A device according to claim 1, substantially as hereinbefore described with reference to, and as shown in, Figure 9 of the accompanying drawings.

5 26. A device for weighing rail-guided vehicles substantially as hereinbefore described with reference to, and as shown in, Figures 10a, 10b and 10c of the accompanying drawings.

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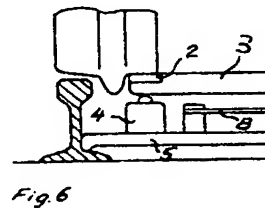
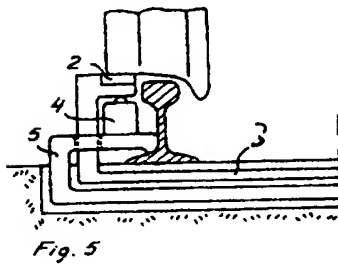
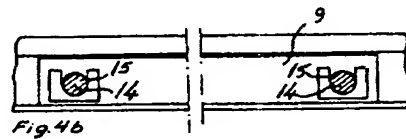
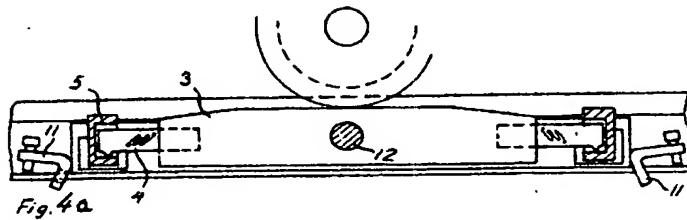
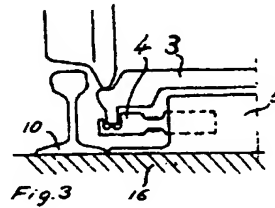
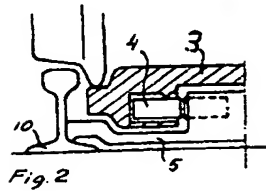
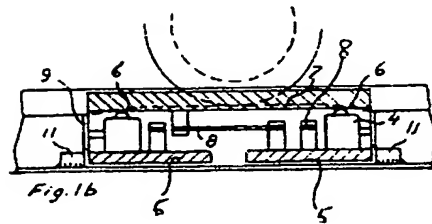
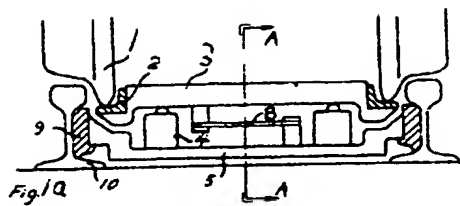
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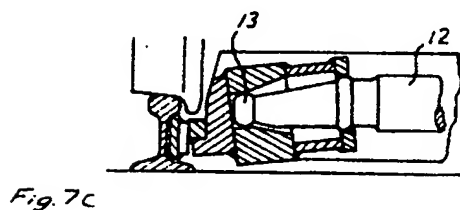
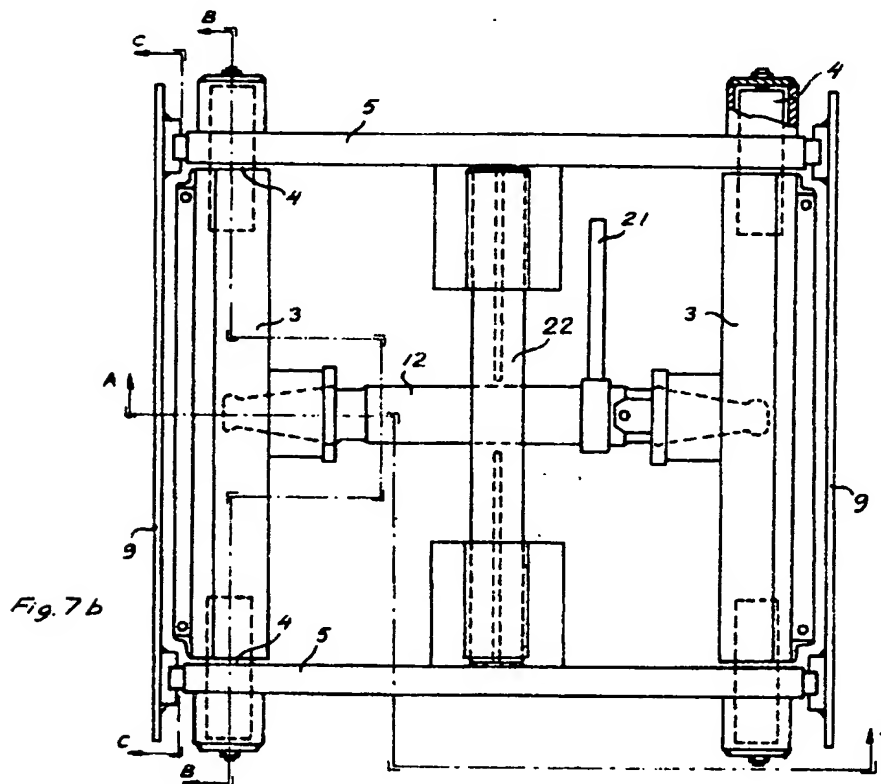
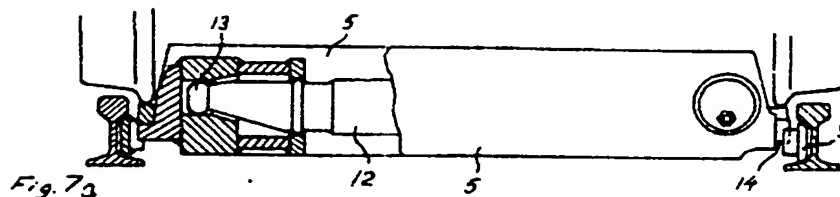
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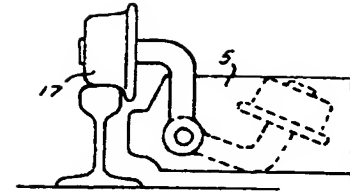


Fig. 8

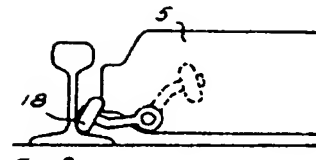


Fig. 9

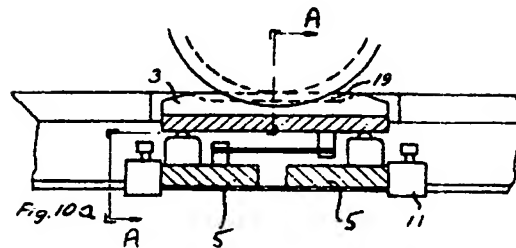


Fig. 10a

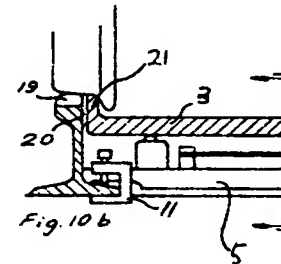


Fig. 10b

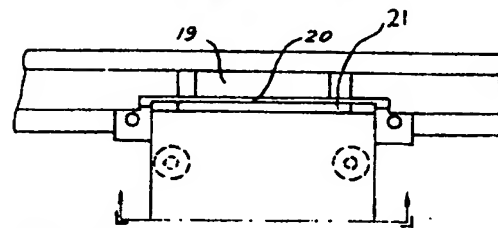


Fig. 10c